The

Gardens' Bulletin

STRAITS SETTLEMENTS,

Into which is incorporated all that has been published as the third series of the Agricultural Bulletin of the Straits and Federated Malay States.

Vol. I. Issued June 22nd, 1915. No. 8.

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THE

GARDENS' BULLETIN,

STRAITS SETTLEMENTS.

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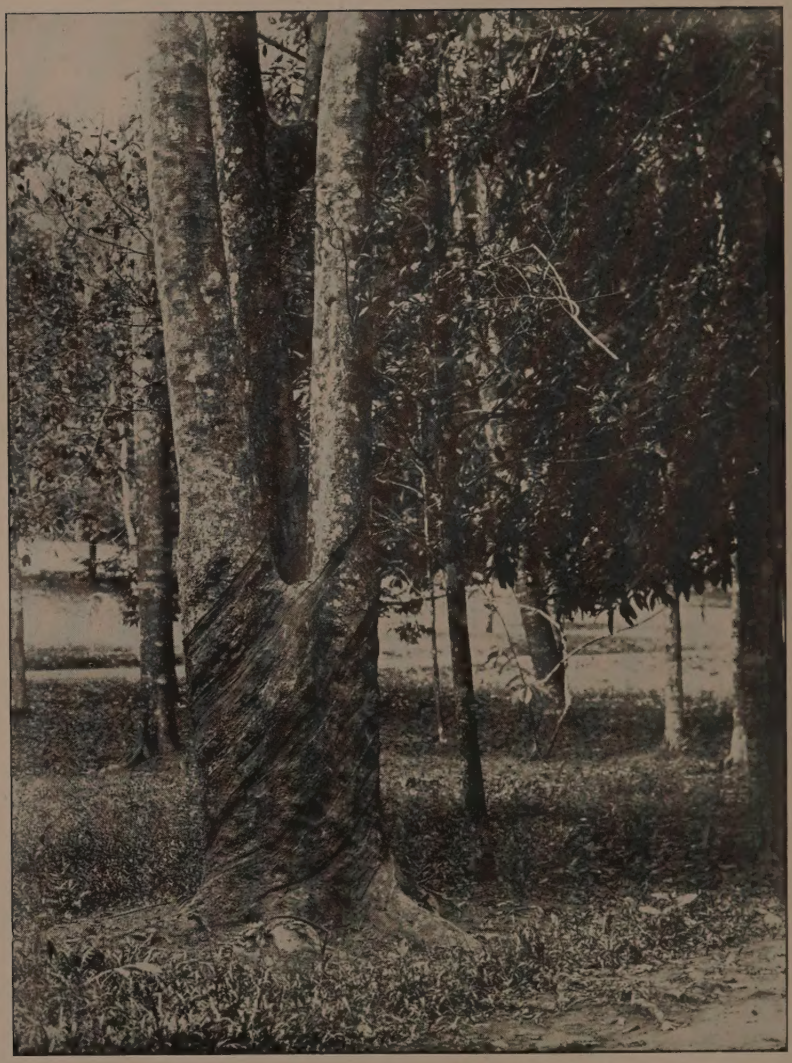

Rubber Tree No. 2, Economic Gardens, Singapore.

THE

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THE TREATMENT TO WHICH THE PARA-RUBBER TREES OF THE BOTANIC GARDENS, SINGAPORE, HAVE BEEN SUBJECTED.

An attempt is being made in the Botanic Gardens, Singapore, to mark down among the old trees the best that they may serve as parents for improved stock. The work of selection will cover many years, and be in some degree tedious; but there is every reason to expect that it will prove worth all the time that may be absorbed. *Hevea brasiliensis*, the Para-rubber tree, in Malaya, shows much variability, and therefore a promise that the general average of the trees can be raised; and moreover not only do we observe this variability here with our own eyes; but we have the assurance of Monsieur Labroy and others that in Brazil great variability can be seen. The work in hand commences with the comparison of tree with tree as judged by the amount of latex given. Were our trees all virgin, this comparison would be facilitated; but they have been subjected to treatment in various ways; and though we do not know as yet, what the effect of tapping is on the life and functions of a rubber-tree, it becomes necessary that in the task before us the past of the selected parents should be known. With this object in view the following record has been compiled from all available sources.

One tree in the Gardens, No. 27, in the year 1904, was recognised as yielding a far greater amount of latex than any of its neighbours, even than those which seemed to have a position quite as advantageous. But it has never been used as a special seed bearer. It and other good trees are now being picked out as parents for the next generation.

A large map of the rubber ground has been prepared, whereon is marked the position of every tree, and wherefrom whenever necessary it can always be ascertained if a selected parent has had an advantageous position or has not.

Unfortunately the tapping records have been unequally kept. In the early days, from 1889 to 1902, they were hardly kept at all. From 1902 to 1903, public interest having been aroused, notices of what was being done in the Botanic Gardens appeared in the local press. From 1904 onwards, they were almost completely kept. Using all the materials which have come to hand, a manuscript record has now been made which shows the nature of the tapping and how it was intermitted in the case of each tree; and the following account largely abridged therefrom avoiding details gives in one view what has happened in the plantation. It, together with the register of the trees and the map above named, serves as the basis in the work to be undertaken.

The failure in 1876, of the first consignment from Kew of Hevea seedlings, fifty in number, to reach the Botanic Gardens, Singapore, alive, has been asserted repeatedly, apparently on the ground of a statement in the Report of the Royal Gardens, Kew, for 1876, which says "the cases did not come into the hands of the Superintendent of the Botanic Gardens . . . . . until the plants were nearly all dead": but when the Report of the Royal Gardens, Kew, for the year 1877 is consulted part of a letter from the Superintendent of the Singapore Gardens is found stating that the Heveas sent in 1876 were making good growth (vide Petch in *Annals of the Royal Botanic Gardens, Peradeniya*, v., 1914, p. 440). So some were saved for at least a year: but no records exist showing their further history. If they lived, they introduced into the Colony plants whose origin was certainly from seed collected by Mr. Wickham on the plateaux between the rivers Tapajos and Madeira; for Kew was distributing these in 1876. Twenty-two seedlings, a second consignment, sent a year later, arrived safely in June, 1877, and more than half of the number were planted out in the Botanic Gardens,—the exact site unknown,—to be replanted in 1878 in what is now the Palm-valley of the Botanic Gardens, then the Economic Garden, where they made poor growth. The other nine were taken to Kwala Kangsar and planted there behind the Residency by Mr. J. H. Murton, the Superintendent of the Gardens in Singapore (vide *Annual Report, Botanic Gardens, Singapore*, for 1878, p. 3; and *Agricultural Bulletin of the Straits and F.M.S.*, ii., 1903, p. 3).

A third consignment is said on the authority of members of the staff of the Royal Botanic Gardens, Ceylon, (e.g., Wright in *Willis, Bamber and Denham, Rubber in the East*, 1906, p. 19) to have been despatched from Colombo for the Singapore Botanic Gardens, in 1877; but its arrival in Singapore is not recorded. Moreover as it was in 1878 and not in 1877, that Thwaites, then Director of the Royal Botanic Gardens, Ceylon, began to send out plants of his own

Photo by] [*H. Overbeck, Esq.*

Hevea brasiliensis, tree No. 174 in the Economic Garden, showing scars of tapping done in 1904.

Photo by] [*Mrs. E. M. Burkill*, 1913.

The path in the Economic Garden between the rubber trees planted in 1886 (on the left) and those planted in 1879. The two most conspicuous trees are Nos. 1 (behind the board) and 2.

propagation, the date appears to be too early for any consignment from those Gardens. That an entry of the despatch of rubber plants from Peradeniya exists in the departmental records seems a fact, but may it not relate to the second consignment from Kew which would pass through Ceylon on its way eastward?

To the charge of the Superintendent of Gardens in Singapore was added in 1879 by the Colonial Government the land which now is the Economic Garden. At the time of being handed over the low-lying part was an indigo plantation, and the hill-slopes above it vegetable gardens cultivated by Chinese, while the hill-top was a more-or-less neglected stretch of secondary jungle (blukar). To the junction of the indigo with the vegetable gardens, Mr. W. Fox, now acting for Mr. N. Cantley who had succeeded to the post of Superintendent but been taken ill, transferred from the Palm-valley the still surviving Para-rubber trees that had been planted by Murton, placing them in a single line. The reader should turn to the first plate in the *Agricultural Bulletin of the Straits and F.M.S.*, II., 1903, for an illustration of these trees at twenty-seven years of age, and to the opposite plate for those still standing in 1913. One of the central trees, No. 5, had died in 1904; and from it, death spread in either direction along the line until in 1913, four trees alone stood; and now there are but three.

It has always been accepted latterly that the parents of these trees grew, in Brazil, on the upland plateaux over the valley of the Tapajos river, whence the seed was collected for the Government of British India, by Mr. H. A. Wickham. But to those in authority in Singapore, in 1878, it was not known with certainty what had been the origin of the stock; and as another of the collectors of Para-rubber seed and plants, Mr. Cross, had officially recommended lands subject to inundation as suitable (vide his letter to the India Office, dated 29th. March, 1877, which may easily be read in Ferguson's *All About Rubber*, 2nd. edition, 1887, p. 59), his descriptions of the flooded lowlands where the Para-rubber tree grows in the Amazon valley were allowed to weigh in the selection of a damp site for the trees (*Annual Report, Botanic Gardens, Singapore*, for 1878, p. 3); and after Murton had expressed himself disappointed with the result, of this first transplanting, Mr. Fox gave them a still damper position. Mr. Fox, who had personal acquaintance with Mr. Cross, and had learned from him the condition of the country near Para, informs the writer that the growth of the trees was much improved by the second transfer.

Cantley at first had no great opinion of Hevea. He wrote in 1885 of the trees in his charge that they "grow well; but in a country where the best rubbers grow wild, it is somewhat superfluous to refer to foreign species, the ultimate success of which may be doubtful." Beyond giving to the trees a little general care, he did nothing to them; and as he was not supplied with funds for the cultivation of the Economic Garden, scrub began to swallow up the lands that had been in cultivation.

It was otherwise in Ceylon. Attention to rubber had been forced on to the Ceylon Botanic Gardens; for on the recommendation of Sir Joseph Hooker, and with the advice of Sir Dietrich Brandis, the India and Colonial Offices had agreed that a big nursery of Para-rubber seedlings should be made in Ceylon to save the situation for India, and enable experimental plantations to be established in Burma as well as in other parts of the Indian Empire. It may be explained that the climate of Calcutta had been tried and found unsuitable, with the first available seedlings, from seed collected for Mr. J. Collins by a Mr. Farris at Cameta, which is to the south-west of Para at some distance (vide *Agricultural Bulletin, Straits and F.M.S.*, ii., p. 2. and Petch in the *Annals of the Royal Botanic Gardens, Peradeniya*, v., 1904, p. 438): they had "utterly failed," Sir George King stated in his *Report of the Royal Botanic Gardens, Calcutta for 1880-81;* and thereupon, as India in other damp regions was ill-equipped with botanic establishments, and in order that the already big outlay should not be lost, Ceylon was asked to find in its humid lowlands some counterpart of the Amazon's forests, where the nursery could be established. Sir Clements Markham (vide *Peruvian Bark*, London, 1880, p. 466) accused the Government of India of being lukewarm, whereas other sources of information show that the India office tried to work apart from Kew, to collect seeds and despatch them independently, and not being competently staffed failed; but in taking the decision to utilise the resources of Ceylon there was nothing but wisdom; and Ceylon became by it at once a new source of wealth to the East.

Under the charge of a gardener named W. Chapman, 1919 seedling Heveas had been sent to Peradeniya in October, 1876, and in the next year the greater part of them were planted out in a purposely acquired plantation at Heneratgoda, on the railway, not very remote from Colombo. All these plants came from the seeds collected by Mr. Wickham on the plateaux over the Tapajos river.

Ceylon received in 1877 a further hundred plants from Kew. Dr. H. Trimen who two years later, *i.e.*, in 1879, succeeded in the post of Director of the Ceylon Gardens, wrote in 1881 (vide *Tropical Agriculturist*, of October 1st, 1881, p. 399) that of 1080 seedlings brought to Kew by Mr. R. Cross without soil, scarcely three per cent. were saved and one hundred of the number transmitted to Ceylon. It is assumed that Trimen in this place referred to the consignment of 1877; and if what Ceylon then received was from Cross' seedlings, then the Singapore consignment of the same date might also be of Cross' collecting, and not from Wickham's seeds. In which case the current view that the old Singapore trees had their origin over the Tapajos valley would be shaken, for Cross collected near the town of Para and on the island of Marajo. The then-Director of the Royal Botanic Gardens, Kew, quoted Trimen's statement without comment in 1898 (vide *Kew Bulletin*, 1898, p. 253); but there is strong reason for believing Trimen mistaken. In the first place Thwaites shortly before his retirement was hardly able to cope with the work which

fell to him and let the records fall into an incomplete state, so that corroboration for the statement cannot be found in Ceylon. In the second place the Kew records, which must be supposed accurate, show that Kew had not 100 plants from Cross' collection in a condition fit to send, and has recorded no such sending. In the *Kew Bulletin*, 1914, p. 164, Sir David Prain writes, that of the 1,080 seedlings without soil which Cross deposited at Kew, on November 23rd, 1876, 680 were sent to Mr. William Bull, the horticulturist, (and their condition on sending is carefully recorded) whereof he saved 14; and 400 were retained at Kew, whereof 3 per cent. were saved alive. Thus about 26 plants alone remained of Cross' collecting; and after recording this the Director of the Royal Gardens says, that there is no entry in the Kew archives which can be interpreted as implying that any of the saved plants ever grew strong enough to be sent to Asia.

It seems then that the accepted origin of our Singapore trees, viz., the plateaux over the Tapajos is correct; and not only is this so, but all seeds and seedlings subsequently obtained from Ceylon to augment the Singapore Gardens' plantation were no more than of the same stock; for Ceylon also had no other.

Thwaites, Director of the Botanic Gardens, Ceylon, in 1876, following a lead given by Kew found means of increasing his supply; for he discovered that he could take cuttings from the seedlings, by using the side branches; and it has been recorded that in 1878 and 1879 he raised and distributed a large number. Mr. Petch (*Annals of the Royal Botanic Gardens, Peradeniya*, v., 1914, p. 460) asks, however, whither went the 1500 plants from the original stock whose disposal in unrecorded unless they were sent out with (or as) cuttings; and it is evidently possible that the Conductor of the Heneratgoda plantation packed and despatched original stock, Thwaites living at a distance being under the impression that cuttings were going out and recording the despatch as such. Moreover Mr. Petch quotes a statement made by Trimen in 1881 to the effect that propagation by cuttings was "extremely difficult and that out of many thousand attempts a very small number" had "succeeded," which throws doubt upon the raising of such large quantities of cuttings as Thwaites' despatches would demand. It is recorded that he sent 500 of these cuttings (we may substitute the word plants for cuttings) to Mergui, a few to Perak, and others (but without success resulting in cultivation) to Madras, Calcutta and Assam. A few years later cuttings (? plants) were sent to the Andaman islands.

The same method of propagation was tried in Singapore and at Kwala Kangsar, but with small or no success (vide *Annual Report, Botanic Gardens, Singapore*, for 1878, p. 3; for 1879, p. 4; and for 1881, p. 4).

The following table gives the early wanderings of Hevea in Asia:—

Early distribution of Para rubber plants.

1876. 1,919 plants from Kew to Peradeniya, Ceylon; 18 plants to Buitenzorg; a consignment which may have failed ultimately to Singapore.

1877. The greater part of the consignment in Ceylon planted out at Heneratgoda. 22 plants to Singapore from Kew, of which some taken to Kwala Kangsar; 4 to Buitenzorg; 8 plants to Mergui, (from Kew) via Calcutta.

1878. Plants sent to Brisbane from Singapore; 500 from Ceylon to Mergui; others to Malabar.

1879. ? plants to the Malay Peninsula, from Ceylon.

1880. 2 plants from Ceylon to Travancore.

1881. 28 plants from Ceylon to the Andaman islands; others to Johor.

1882. Plants from Ceylon to British North Borneo.

1883. Seeds from Singapore to Sarawak and Kwala Kangsar: 27 stumps from Ceylon to Malabar; 12 to Mr. Davidson in Singapore.

1884. 26 stumps from Ceylon to Malabar, and also seeds.

1885. 300 seeds from Ceylon to Malabar; 400 to Singapore.

1887. Seeds from Ceylon to Mergui and to Malabar, and also to Penang and N. Borneo; seeds from Kwala Kangsar to Taiping.

1888. 11,500 seeds from Ceylon to Singapore and to Kwala Kangsar; 3,000 seeds from Ceylon to Central India.

The very first tree to flower in the East seems to have been one of those which were taken by Murton to Kwala Kangsar; for it is recorded that a tree there flowered in March, 1880, at the age of 3½ years.* Another flowered at Heneratgoda. In the next year one at Heneratgoda yielded nine seeds and in 1882 thirty-six seeds (Trimen in *Kew Bulletin*, 1898, p. 254). At Kwala Kangsar the tree which flowered first, flowered again, but without fruiting; however at its third flowering in 1881 it set fruit, and in doing so was accompanied by another tree which then flowered for the first time (Petch in *Annals of the Royal Botanic Gardens, Peradeniya*, v., 1914, p. 445). In 1882, nine trees flowered and fruited at Heneratgoda. Probably in 1883† trees first fruited at Singapore; and seed was now sent from the latter place to Sarawak and Kwala Kangsar. But not until 1884 was there any flowering at Peradeniya and Mergui.

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* Equally early flowering was recorded in the *Agricultural Bulletin of the Straits and F.M.S.*, VI, 1907, p. 176; and yet earlier in the *Report of the Forest Department Ceylon*, for 1894.

† The date of the first fruiting of Hevea in Singapore cannot have been 1881 as stated in the *Agricultural Bulletin of the Straits and F.M.S.*, iv., 1905, p. 365, for Cantley in his *Annual Report on the Botanic Gardens, Singapore*, for the year 1882, p. 12, wrote "an early crop of seed is looked forward to" as growth had been good in spite of the throw-back suffered from the poverty of the soil into which they had been transplanted in 1878.

Trimen when he succeeded Thwaites in 1880, found at Heneratgoda "about 300 of the original seedlings" grown to trees, "and at Peradeniya above 20 trees." By cuttings he raised his stock between 1880 and 1894, to 424 at Heneratgoda and 30 in Peradeniya (Trimen, in *Kew Bulletin*, 1898, p. 254).

The Ceylon seed crop, with such a large number of trees, soon reached considerable dimensions, so that it was above 20,000 in 1888; and out of it many places received supplies. The Singapore seed crop was at first used up between the Botanic Gardens, Sarawak, Kwala Kangsar, Kuala Lumpur and Malacca. In the Botanic Gardens, the old indigo ground was chiefly planted up, making a fine heritage to us who come after, and in 1894 some rubber was planted among the trees of the southern corner of the Economic Garden (vide *Agricultural Bulletin of the Straits and F.M.S.*, vii., 1908, p. 253). The smaller Kwala Kangsar crop increased the local plantation and supplied the seedlings which became widely distributed here and there over Perak and on the estates of Mr. T. Hislop Hill § and others in Selangor and Negri Sembilan; and in 1887, they were also the source of a small plantation at Taiping. One of Mr. Hill's estates was Linsum, which again in turn supplied seeds in 1899 to Deli, Sumatra. The Mergui seed crop was used up locally.

The first tapping of Hevea, done in the East, was done by Trimen in October, 1882, and was thus described by him.—"Five of the Hevea trees were prepared by scraping off on one side the rough outer surface of the outer bark; a few short cuts were then made with a knife and the rubber allowed to dry." The first tapping of Hevea by the herring-bone method was done by Dyaks (Wray says Malays) on Sir Hugh Low's request at Kwala Kangsar in the year

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§ At p. 213 of this Bulletin a very promiment place was given by Mr. Hislop Hill as "the first planter" of rubber in the Peninsula on the authority of Mr. Ridley. Subsequently the following letter from him to Mr. W. Egerton was discovered in the Botanic Gardens, being one of the very few on rubber which have escaped white ants. It is given here to show in what way Mr. Hill was a pioneer.

Bukit Nanas, Sungei Ujong,
1893.

Sir,

I have the honour to acknowledge your letter Misc. 1934/34.

I enclose you a small sample of rubber grown on Linsum Estate from the Hevea brasiliensis and shall be glad to hear what it is worth. The trees are 6 to 8 years old and the yield from one tree is about half a pound and, by the method of collection followed, costs abou 20 cents per pound to collect.

2. I have hundreds if not thousands of trees on my estates; and I shall be glad to supply any quantity of seeds that the Government may wish to buy.

3. The difficulty appears to me to be in collecting the rubber in a sufficiently pure state for the market at a reasonable price.

4. I have found the trees do as well on undulating ground as on the edges of swamps.

I have, etc.,
(Signed) T. H. HILL.

It is believed that the rubber was very inferior and that Mr. Hill got no further at this date than growing scattered trees for seed. But the possession in 1893 of trees 6-8 years old puts him far in front of any other private individual as a cultivator of Hevea.

1888. Collins (*Report on Caoutchouc of Commerce*, London, 1872, p. 36) had described herring-bone tapping as done "in Para, Guiana," etc., by making a vertical cut from high up the tree to the base and numerous short side cuts which were not reopened at all (or at least Collins makes no mention of reopening them). The Dyaks, however, borrowed no ideas from such a source. They tapped the trees rather in the way by which they sometimes draw birdlime or the Samangs draw the juice of the Ipoh tree—*Antiaris toxicaria*, Lesch. (vide *Kew Bulletin*, * 1891, p. 260 and also L. Wray in Ferguson's *All about Rubber*, 1899, p. ccxxxviii). They cut—perhaps one should say hacked—rough herring-bones, but were not exactly successful, it being reported "that scarcely any juice exuded from them." (*Agricultural Bulletin of the Straits and F.M.S.*, ii., 1903, p. 3).

Trimen's 1882 tapping was merely to see if he could get rubber, and in the years immediately following he did not repeat the experiment. But in 1888 he restarted experimental tapping by a modification of the Brazilian method of making numerous small incisions. It is recorded that he tapped but one tree; and that he continued his demonstrations upon it in the years 1890, 1892, and 1894, i.e., in alternate years. These tappings were done timidly for fear of injuring the tree, thus he made cuts in the tree on seventeen days only in the year 1888, seven being near the commencement of the year, in the months of January and February, six at the middle, in in July and August, and four at its close in December. The next tappings were like the first.

In 1889 at Mergui similar rather timid tappings were tried (*Kew Bulletin*, 1898, p. 266).

In 1888 Mr. H. N. Ridley became Director of Gardens, Straits Settlements, and visited the Ceylon establishments on his way to the East (*Agricultural Bulletin of the Straits and F.M.S.*, ix., 1910, p. 202).

When he took over charge in Singapore, there existed in the Economic Garden at least nine trees of the row transferred in 1879, twenty-one trees which had been planted in 1884 and were seedlings from the foregoing, or from Kwala Kangsar thirty trees which had been planted out in 1886, and probably in part came from the Ceylon seed imported in 1885 in a Wardian case, and 1,138 seedlings a year old, and again doubtless from the Gardens' own seed. He at once set to work to care for these, and raised another 8000 plants from a consignment of Ceylon seed.

He tapped to ascertain yield in 1889, (*Agricultural Bulletin of the Straits and F.M.S.*, ix., 1910, p. 202) one year after his arrival, and he reported that the trees "thrive in the damper spots, and those old enough to cut produce a considerable quantity of rubber" (*Annual Report, Botanic Gardens, Singapore*, for 1890, p. 4). Rubber produced from them was exhibited at the Agricultural Show held in 1890 (*Agri-*

* Sir Hugh Low had interested himself in the Ipoh tree in 1881, vide *Kew Bulletin*, 1891, p. 26.

cultural Bulletin of the Straits and F.M.S., ix., 1910, p. 202). To obtain it "the trees were tapped in the herring-bone method," and the latex was collected in cigarette tins and allowed to coagulate naturally "in the tins without the use of acid" (*Agricultural Bulletin of the Straits and F.M.S.*, ix., 1910, p. 202). A pruning knife and a narrow flat chisel seem to have been the implements used in tapping: with the knife the first cut was made, and the repeated shaving was done with the chisel, a wooden mallet being used to drive it forward. One piece of rubber made in these early tappings is preserved in the Botanic Gardens, Singapore, as well as a second of a slightly later date made when saucers were used for coagulation.

Again in the year 1889 an attempt was made to get rubber from the Kwala Kangsar trees, but with no greater success than before, apparently because the herring-bone incision was not wide enough and not reopened, being just an imitation of the method of tapping for Ipoh juice. The great success came in that year—not at Kwala Kangsar, but was Mr. Ridley's. His resort to reopening the wounds was indeed second only in importance as regards the planter to the actual introduction of Hevea into the Old World, and after it the greatest advance that had been made in rubber since the invention of vulcanisation.

As said above, Collins wrote in 1872 of herring-bone tapping extending high up the trees with a large number of side cuts; the plan of Ridley's first tappings seems to have been taken from those tappings, although the vertical channel was generally only two feet long, and to have been variable in extent and in the number of the side cuts; but fearing that the wounds would not heal he ceased the re-opening when the side cuts had a width of half an inch; and the next herring-bone was made in a new place (vide *Agricultural Bulletin of the Malay Peninsula*, No. 7, 1897, p. 136). Considerable experience seems to have been obtained between this commencement and the date (1897) of the Bulletin just quoted, which indicates a not inconsiderable amount of tapping.

This tapping used to be done in the evening, the cups being left on the trees through the night, after the fashion described by Collins on page 8 of his *Report on the Caoutchouc of Commerce.*

In 1895 Dr. J. C. Willis having succeeded Dr. Trimen, the course of the work in Ceylon changed. Dr. Willis tapped again without waiting a year, the tree which Dr. Trimen had been tapping in every other year, and reported that he judged it, at nineteen years, old enough to be tapped annually; he commented by estimating the yield of trees such as it at 100 lbs. per annum from an acre carrying fifty trees. Though bolder tapping was now coming in, the implements were "a ¾ inch chisel, a wooden mallet . . . . and a knife." Dr. Willis' method of tapping was described by him in a *Circular of the Royal Botanic Gardens* (No. 4, 1898, p. 30) thus:—" the tree is first carefully and lightly shaved with the knife from the height of six feet down to the ground; . . . . a clay gutter is next made round the tree about

six inches from the ground, so arranged as to catch the milk; . . . . incisions may now be made in the bark with the mallet and chisel, commencing near the top of the cleared portion. a V-shaped cut is made in two strokes . . . . . a second V-shaped incision should be made about a foot below the first and others at similar distances down to the gutter at the base of the tree. Another set of incisions may then be made parallel to the first at about 10-12 inches from them, and other vertical rows of cuts may be made if there be sufficient room for them." The subsequent tapping was by intercalating fresh V's.

A little later, when Mr. J. Parkin was associated with Dr. Willis, the Ceylon method was subjected to further experiment. The vertical rows of Vs were one foot apart, and the first Vs in the rows also one foot apart. The second incisions were made midway between the first, and thus more or less six inches from them. The third incisions were between the first and the second incisions in every other of the now doubled interspaces, so that the number of cuts was not increased. Thus was the tapping continued (vide Willis, *Circulars 12-14 of the Royal Botanic Gardens, Ceylon,* 1899, p. 133). One tree carried eight rows of these superposed V's; others fewer according to girth. The making of wounds in the form of an X was tried and other variations of the principal scheme; but never was excision or reopening of the wound tried: and the conclusion was reached that "if a double cut be made, the V form is the best (p. 123). A carpenter's chisel and a mallet were used: and to planters it was recommended that the chisel be 1-1½ inches wide, and wedge-shaped.

It is most interesting to observe that the Malayan method had not touched Ceylon yet; and also that either place held to its own course, though soon after this Singapore was advised to abandon the method which Mr. Ridley had so successfully devised. This was in 1898 when Mr. Wickham, returning west from a stay in Polynesia, visited Singapore, and recommended the incision method of tapping of the Amazons, so familiar to him (*Annual Report, Botanic Gardens, Singapore, for 1898,* p. 6); but he did not carry his advice, and there is no record of any use of the method resulting; instead on the other hand not long after the bias towards the herring-bone excision method was asserted afresh (vide *Agricultural Bulletin of the Straits and F.M.S.*, ii., 1903, p. 45). Remarks published on page 332 of the Bulletin of 1902, give one reason why.

In 1896, one tree in the Waterfall Gardens, Penang, came under tapping; and Mr. C. Curtis who tapped it, used a herring-bone with three cuts on each side. There is a plate of this tree in the *Agricultural Bulletin of the Straits and F.M.S.*, for July, 1902, showing it as it was in the year 1902; and, although not very distinct, the reader may, therein observe the nature of the herring-bones used; several can be seen, the last nearly vertically above two others.

The four posts around the tree carried the low platform on which the tapper stood to reach the top parts of the last herring-bone.

Curtis clearly described his method in the *Agricultural Bulletin of the Straits and F.M.S.*, i., 1902, p. 511, thus: "A small perpendicular channel a foot or more in length, and about one eighth of an inch broad, but not deep enough to obtain much rubber is first made, and at the base of this is affixed the tin or other receptable to receive the latex. The channel is not subsequently enlarged: . . . . leading to this channel diagonally are made two or three incisions on either side which supply the latex, and from the upper surface of which a thin shaving is removed every morning, or every alternate morning . . . . . thirteen times which, with the initial opening of the cuts make fourteen operations."

In 1897, Mr. L. Wray tapped at Taiping, (*Malay Mail* of January 19, 1898, quoted in Ferguson's *All about Rubber*, p. ccxxxxiii.) and Mr. R. Derry at Kwala Kangsar, (vide *Perak Museum Notes*, ii., part 2, p. 101, as well as the last reference), both using the herring-bone. Later tappings by Mr. Derry at Kwala Kangsar are recorded in the *Agricultural Bulletin of the Straits and F.M.S.*, i., 1901, p. 20.

Curtis' plate referred to, and the expressed statements of Messrs. Wray and Derry show that the side cuts were opposite, and Mr. Wray remarked that in healing this proved disadvantageous, (*Perak Museum Notes*, ii, 1897, p. 96, reprinted in Ferguson's *All about Rubber*, 1899, p. c), for the covering up of the wound was slow at the points where two side cuts made with the vertical channel an unusually wide wound. He suggested with a diagram that the side cuts should alternate.

Experimental tapping, commenced in 1900 at Tjikeumeuh in Java, by Dr. Tromp de Haas, was by excising the lower edges of oblique cuts in series by a chisel on nine successive days (vide *Agricultural Bulletin of the Straits and F.M.S.*, iv., 1905, p. 286).

Tapping in Singapore was done over all the years about this time for various purposes, often for the instruction of a visitor and to demonstrate rubber: these tappings went unrecorded; but one is mentioned in the *Annual Report of the Botanic Gardens*, for the year 1900, page 7, wherein an attempt was made on a single tree five feet five inches in girth, to ascertain how long it required to tap it dry, and its wounds were reopened on eighty-four successive days until this happened. It is a pity that the subsequent history of the tree is unknown.

It is evident that other trees received a much lighter treatment.

Right from 1889 tapping seems to have been done irregularly; and the number of trees used for it apparently exceeded 150 by little, of which number 134 were standing in 1904.

In 1901 Mr. Ridley went on long leave; and with this what may be regarded as the first period of experimental tapping in the Botanic Gardens, Singapore, came to an end.

In the same year Mr. Stanley Arden came out from Kew to take charge of the Perak rubber plantations, etc. In his experiments at Sitiawan, in Perak (1901-02), the form of the wound varied greatly, but it was always excised (*Report on Hevea brasiliensis,* Taiping, 1902). He used at first a carpenter's chisel and a wooden mallet, but entirely discarded these later in favour of a very sharp pruning knife. He experimented with straight cuts at an angle of 30° six inches apart, six inches long in a vertical series of twelve (to find out which part of the trunk should be tapped) reopened ten times, five each day over twenty-four days; and (2) V-cuts in series of five or of twelve, each limb six inches long and the angle as before, reopened five times or ten times over twenty-four days or twelve times over twenty-four days; and (3) herring-bone cuts at different heights, each vertical channel 2½ feet long draining six side channels in all, each one foot long, reopened on fourteen consecutive days; or (4) herring-bone cuts one foot long with three feeders two on one side and the third on the other, eight inches long and one foot apart, reopened on eight consecutive days.

The conclusion was reached that cuts or small herring-bone cuts on the lower part of the trunk not above six feet appear desirable (p. 11).

Mr. Derry at Kwala Kangsar in this year was using herring-bones with the "centre channel about four feet" long having "five oblique cuts on each side"; three herring-bones were made on each tree (Annual Report quoted in *Agricultural Bulletin of the Straits and F.M.S.*, i., 1902, p. 327).

When Mr. Ridley returned from leave in 1902, it appears that more regular tappings were instituted in the Botanic Gardens; and when on July 1st., Mr. A.D. Machado joined the department, the latter took charge of the work. Herring-bone incisions were used (vide *Agricultural Bulletin of the Straits and F.M.S.*, ii., 1903, p. 45): and in one or two they were carried up to an unusual height as is seen in the plate included in this number. The plate in question well shows how the side cuts were opposed in spite of Mr. Wray's excellent advice.

In February 1903, a Monsieur Bonnechaux, who had lived among the seringueros of the Amazons, visited the Gardens, and advised against the excision method in use, saying that it would kill trees in the Amazon region very rapidly; and he recommended the incision method that he had used himself in Brazil. So far he carried his point that under his direction 150 trees were tapped (vide *Agricultural Bulletin of the Straits and F.M.S.*, ii., 1903, p. 45). Some of these trees were virgin, but many had been tapped before.

Scars of a Herring-bone tapping which was carried to an unusual height.
Economic Gardens, Singapore.

It is interesting that M. Bonnechaux only a few months after Mr. Arden had remarked on "the rapidity with which the wounds heal" *(Report on Hevea brasiliensis*, p. 13), should have insisted so strongly that the trees tapped by herring-bones "would in the Amazons be speedily destroyed by insects attacking the exposed wood" (l. c., p. 45) and obviously M. Bonnechaux's knowledge of Malayan conditions was slight. Nevertheless Mr. Arden had feared to reopen the cuts that were becoming wide, and had desisted from tapping in every case beyond the fourteenth time. But on the whole the remarks of both men really point us to the amount of damage that was done by the tapping implements used. *

After M. Bonnechaux's few days stay were over, Mr. Machado continued to tap as started by him, but using only 100 trees. He tapped from March 4th. to May 27th. *(Agricultural Bulletin of the Straits and F.M.S.*, ii., p. 47, 112, and 264). He made one cut only with the axe on each of the first five days, and then two cuts to each tree on each of the next four days, and then ten cuts four times on twenty trees or five cuts once on forty trees but thereafter four cuts for the most part on every other day up to twenty three repetitions.

These 100 trees so treated were certainly chosen from among the 150 tapped by M. Bonnechaux; and it is recorded that they all stood in the triangle of the plantation near to the entrance gate (l.c., p. 46), which we now call Block 1.

Tapping at this date was done no longer in the evening, but in the morning.

"Conjointly ten large trees growing under more favourable circumstances than the hundred were tapped eighteen times in seventy-five days" *(Agricultural Bulletin of the Straits and F.M.S.*, ii., 1905, p. 113, vide also p. 266) by M. Bonnechaux's method. These trees can only be those standing in a row which were the oldest that the Gardens possessed. It is recorded along with this information that in previous years they had been very heavily tapped by the herring-bone method (p. 112). "Very heavily" in this case would mean that they were abundantly scarred by reason of the repetition of tapping in different parts of the trunk, not that they had been submitted to any continued tapping.

Mr. Machado now set aside another 100 trees, and tapped them by M. Bonnechaux's method twenty-three times in thirty-three days, commencing on May 29th., (l.c. p. 265). One cut was made on the first day and on the four following days; two cuts were made on the next four days, then four, and after that more up to ten cuts. The reader by turning to the plate issued with the *Agricultural Bulletin of the Straits and F.M.S.*, for November, 1903, may note

* Many were fully aware of this. Mr. Ridley in 1897 (*Agricultural Bulletin of the Malay Peninsula*, No. 7, p. 136) and the writer of the article "rubber" in *Spon's Encyclopaedia* had alike suggested a guard on the knife put into a coolie's hand for tapping.

the ten cups on a tree. Mr. Machado also tapped a further lot of ten trees six times commencing May 29th. (l.c., p. 266) by M. Bonnechaux's method. In the *Straits Times* of April 16th, 1903, the cuts are said to have been 1½ inches long by ⅛ inch wide, and in the *Straits Echo*, (reproduced in the *Tropical Agriculturist* of September 1st, 1903, p. 154) it is said that the cuts made were two inches long.

Next, commencing on July 8th. 5 large trees were tapped fifteen times in nineteen days by herring-bones, a semicircular chisel being used for the reopening of the wounds. The reader will note the change in the shape of the chisel used: and it is interesting to record that on the Bukit Lintang Estate in Malacca, tapping in 1904 was done by means of a similar implement (vide *Tropical Agriculturist* for October 1st., 1904, p. 240).

At the end of July, 1903, Mr. Machado left, and Mr. C. Boden Kloss came. Tapping was continued and Mr. Kloss informs the writer that he corroborated Mr. Machado's results.

With Mr. Kloss' departure ended the second period* of tapping in the Singapore gardens.

During this short period it was realised that the trees are resistant enough for tapping much more prolonged than anything done previously, if only the tapping be wisely done. Machado had bled trees on every other day for six months (vide *Straits Times* of April 16, 1903, reprinted in the *Tropical Agriculturist* of June 1st, 1913, p. 839); and it was written "From 100 trees averaging from 12 to 15 years of age, and planted much too closely to admit of their being properly developed, Mr. Machado drew on an average about three pounds of dried rubber daily and he expects the supply to be maintained for six months working half the trees each day during that period. Then these trees will be given a rest of six months." Much in contrast with Machado's results is a statement made in *Teysmannia*, 1903, No. 8, to the effect that it had been possible at Soebang in Java to reopen half herring-bone cuts on alternate days only ten times and at Buitenzorg only fifteen times.

Four government trees in Malacca, fourteen years old, were tapped by herring-bones in 1903 by Mr. Gagliardi on eight days, and then by two herring-bones on fourteen days (*Agricultural Bulletin of the Straits and F.M.S.*, ii., 1903, p. 191).

With the coming of Mr. R. Derry to Singapore in the commencement of 1904 fuller records of tapping in the Botanic Gardens

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* In summary it may be stated that to this date the Garden's trees had been tapped thus:—

Tappings by Mr. Ridley,—number of trees unrecorded 1889-1903.
Tappings by Mr. Bonnechaux—150 trees for a few days.
Tappings by Mr. Machado—215 trees, 100 having been virgin.
Tappings by Mr. Boden Kloss,—a continuation of the last.

Greatest number of trees tapped as indicated by these records 250, being 150 by M. Bonnechaux and 100 virgin trees by Mr. Machado. How many over and above this figure had been tapped it is impossible to state, but it is believed that the number was small.

commenced. In the first place all the standing trees—1285—were numbered serially, and a record of their condition compiled. From this record we learn that the standing trees which had been tapped were 234; therefore at least sixteen had died in the last year. And from the same useful record we learn which trees were of 1877 and some of other years.

Under Mr. Ridley, Mr. Derry now set out "to experiment on the . . . . trees planted in 1886, 1887 and 1888" (*Agricultural Bulletin of the Straits and F.M.S.*, iii., 1904, p. 332), having before him a series of objects, one being for instance to ascertain in what part of the day tapping should be performed; another to demonstrate how incision after the Brasilian method is inferior to excision; a third to enquire into the relative value of distributing lines of excised cuts over the bark against making a single excised line, and so on. With the results on latex, we are not here so much concerned as with the amount of cutting that the experiments involved and the way in which it was done. By the end of 1904 Mr. Derry had tapped 850 trees.

Four reports were published on the experiments of the year. The first was over Mr. Derry's name and appeared in the September number of the *Agricultural Bulletin of the Straits and F.M.S.*, where despite the month given on the cover of the part, it carried the record of tapping into October; the second appeared as a continuation of the first in the November number of the Bulletin and prolonged the record to the middle of that month, and the third in the April and May, 1905, numbers; the fourth under the joint names of Messrs. Ridley and Derry was a Report to Government, dated 7th. November, 1905, which was printed separately and also in the *Agricultural Bulletin of the Straits and F.M.S.*, for November, 1905, vol. iv., 1905, p. 424. From the prefatory remarks to the last cited it is learned that tapping was done in March, April, May and June, but that this was not altogether satisfactory, so the recorded experiments actually were dated from July 4th.

Experiment I of 1904, had for its first object the ascertaining of the time of day—morning or evening—at which trees should be tapped; and it had as a second object the comparison of M. Bonnechaux's Brasilian method with excision along oblique cuts. Instead of the small axe after the Brasilian model which had been made for M. Bonnechaux, a half-inch carpenter's chisel was used; the cuts were distributed all over the lower part of the trunk of the trees set aside for the purposes. Ten cuts were made per diem. The same implement was used for making the oblique cuts on the trees of the contrasting part of the experiment. The tapping of these trees was by superposed converging or diverging cuts—the cuts in two series not near enough to make Vs or inverted Vs; in some of the trees the cuts converged downwards and in others diverged downwards. In a comment Mr. Derry described the design as "a herring-bone without a central channel;" but the description is

hardly good, regardless of its paradox, for the two series seem to have been separated by at least four inches of uncut bark. The lower edge of the cuts was excised at each tapping. Two excellent illustrations of this method of tapping were given on page 168 of the *India Rubber Journal*, for July 31st, 1905, the trees being No. 196 and another now dead; further, tree 152, similarly tapped, can be seen in one of the illustrations on page 166.

Experiment 2 also compared morning with evening tapping; and it compared Bonnechaux's Brasilian method, subject to the change above noted in the tool used, with tapping by ten long oblique cuts reopened at different intervals of time, and with herring-bone tapping.

Mr. H. Overbeck has very kindly put at the writer's disposal a photograph of tree No. 174 which shows the scars of the tapping after Bonnechaux, done on that tree in 1904. Tree 356, treated in the same way, was figured in the plates attached to the November, 1905, issue of the *Agricultural Bulletin of the Straits and F.M.S*, and tree 148 was excellently figured in the *India Rubber Journal*, for July 31st, 1905, page 166, as well as others now dead on page 169. Mr. Overbeck's photograph is here reproduced on plate 2 (p. 249). Ten of the little cuts seen in it were made daily in the experiment. The first contrast to it was of tappings by converging cuts superposed in a series—just as described under experiment I; and the second contrast to it was of herring-bone tapping. The herring-bone tapping of this year has been well illustrated. A plate showing a herring-bone scar of 1904 on tree No. 2 was given with the issue of the *Agricultural Bulletin of the Straits and F.M.S.*, for July, 1908: another plate of tree No. 2, is issued with this number which also shows a herring-bone scar of the same year. The plate issued with the number for June, 1905 of a tree now dead shows the scar of 1904 which has ten side cuts, as well as the ends of an earlier scar which has but eight. This tree was one of a row figured on page 167 of the *India Rubber Journal*, of July 31st, 1905, more of which are there seen to have been tapped in the same way in 1904. A plate prepared long ago, but only now issued with this number shows a scar of the year on the tree No. 7 with five cuts on one side and six on the other. It is on the whole evident that herring-bone tappings of this year had generally five cuts on each side. It also evident that in making the converging cuts of the contrast, there were five pairs of converging (or diverging) cuts, so to give approximately the same amount of cut surface in each case. But of course in the imitation brasilian tapping the cuts being short, very much fewer laticiferous vessels would be made to bleed than in the two contrasts; and naturally the method produced much less rubber; the experiment thus was a not quite fair one; but with the results in rubber we are here little concerned. In connection with the cutting resulting, the reader's attention is specially directed to the last quoted plate; for in it the pruning knife, used in making the first cuts and sometimes afterwards, is distinctly seen.

Experiment 3 may be called a variant of experiment 2; but 5 cuts only were made daily in those trees given over to the modifcation of M. Bonnechaux's method. Tree 342 which was one of the trees tapped by five cuts daily, can be seen in illustration 6 on page 163 of the *India Rubber Journal*, July 31st, 1905.

Experiment 4 while repeating the morning-versus-evening experiments, contrasted the results of daily and alternate day tapping by the use of the herring-bone method.

Experiments 5 and 6 were an elaboration of experiment 2.

The year's results were held to condemn afresh, the brasilian method of M. Bonnechaux, although, as said, from the point of yield it had a hardly fair trial; they indicated morning tapping as the right thing, and they suggested that alternate day tapping by herring-bones would yield more than daily tapping per unit of labour. Incidentally the inconvenience of multiplying the number of cups on the trees became evident, although the ten long cuts converging in pairs did yield at a high rate.

In no single case were the cuts reopened more than twenty-eight times; for it was feared that the tree might thereby be killed. It had become more clearly recognised that the tapping implements used were ill-suited to the purpose; and in the end of the first of the reports Mr. Derry pointed out that the danger lay in the depth of the incision and not in the quantity of surface removed; he added that the half inch carpenter's chisel "is not an instrument that can be commended, as apart from the possibility of punching too deeply, there is also the danger of raising the bark." It has been mentioned above that Mr. Arden discarded it.

The carpenter's gouge which at this time was being used on the Bukit Lintang Estate, was there too recognised as liable to cause injury and the tapping was limited to two short periods per annum of only fifteen days—fourteen reopenings.

The year 1905 was hardly an experimental-tapping year as regards the trees in the Botanic Gardens, Singapore, used in 1904; for though the trees were tapped, they were treated in a tapping rotation; and they were all cut in herring-bones, but with varying periods of reopening. A report appeared in the *Agricultural Bulletin of the Straits and F.M.S.*, v., 1906, p. 439.

The trees which had made experiment I, in 1904, were all tapped alike, and twice within the twelve months—just a little more boldly than were the trees of the Bukit Lintang Estate, for there were twenty-four and twenty-one reopenings of the wound at the respective periods. The trees of experiments 3, 4, 5 and 6, at a different time for each group, were tapped alike. But as there had been a considerable number of deaths among the trees either by wind or by *Fomes* or by other causes, new trees were put into the tapping rounds to

make up the numbers. The trees which had made experiment 2 in 1904 only, were not all treated alike,—this not by varying the tapping but by deferring it in the case of a part of the trees so that the resting intervals became unlike.

There was, however, an experiment in tapping, which was called 7, but which will be called Experiment U here to distinguish it from a later experiment 7. Experiment U was an attempt to estimate the relative values of daily and alternate day tapping, and is to be regarded as the conclusion of the experimental work of 1904.

But besides the working of these trees by Mr. Derry into a tapping rotation, there was other tapping done in the Plantation in the early part of the year. In the first place Mr. Ridley tapped about 24 trees for various purposes; and in the the second place, Mr. Burgess, then Government Analyst in Singapore was allowed the free use of a considerable number of trees, whence he drew latex for experimental work in factory processes. There is no record of the way in which these trees were tapped, but reason to believe that new tapping tools were used and designs of cuts were tried.

Tapping knives were not used as far as is known, in Mr. Derry's tappings of the year; but the tapping was done as before with the pruning knife and chisel. The Ceylon Gardens at the time were using tapping-knives, for Mr. Herbert Wright who was then in charge of rubber work at Heneratgoda, which he had systematised in October, 1904 (*Tropical Agriculturist*, xxv., 1906, p. 309), was employing the Northway-Bowman knives in his tapping. And already on the Culloden Estate on seven trees from 1891 "every known method of tapping" had been tried (*Tropical Agriculturist*, May 2, 1904, p. 764). The first record of the use of tapping knives in the Singapore Botanic Gardens in Mr. Derry's experiments was early in 1906, when several sets of this particular knife (the set is of three knives) were procured from Ceylon, and tried, but it is believed without finding favour; and when a little later a tapping knife, was definitely adopted in the Singapore Gardens, after various trials, it was of the farrier's knife pattern as described in the following statement * by Messrs. Ridley and Derry, (*Agricultural Bulletin of the Straits and F.M.S.*, v., 1906, p. 460)." The implement capable of making the cleanest and quickest incision is the ideal one. This we have found in an English . . . . modified farrier's blade adjusted by a screw in a sliding socket . . . . Nearly all invented knives or tools have been experimented with at the Botanic Gardens; some have been found unhandy, others unsuited for coolie use, and some much too fragile."

The application of the farrier's knife to rubber has a long record. As for back as 1872, Collins had described and figured a form of it

* The statement occurs in the report on the Tapping experiments of 1905, but was written towards the end of 1906.

Photo by] [*H. Overbeck, Esq.*

Photo by] [*H. Overbeck, Esq.*

Spiral tappings of trees Nos. 2130 (on the left) and 2. The scars of an older herring-bone tapping may be seen on tree No. 2.

used for marking timber in Germany, suggesting that it should be tried for tapping rubber trees. His suggestion however did not bear fruit and was forgotten as planters had no need of tapping knives. History repeated itself and the same idea came forward again when Wray to help on his experiment at Taiping made what was but a small modification of the same knife. Later, it seems quite independently, Mr. F. A. Stephens, then manager of the Jebong Estate in Perak, reproduced the device. Though we call it the Jebong knife now, the principle and its application to rubber are much older than rubber on the Jebong Estate. Its simplicity is the chief cause why it has found favour in the Malay Peninsula: whereas ingenious patents have generally been the produce of Ceylon.

In 1906, experimenting was renewed in the Botanic Gardens, at Singapore, the trees which had served for experiments 4 and 5 in 1904 being used, while those which had made the other experiments were tapped in rotation as in 1905. To all groups additional trees were added where death had made gaps. These additional trees were a very mixed lot: some had been tapped before 1904; some had been tapped by Mr. Ridley in 1905; some had been tapped by Mr. Burgess in 1905; some had been part of experiment U; and some were virgin. Added to the experiments now was an experiment 7 a comparison of herring-bone tapping with spiral tapping and at the same time a trial of the pricker. Spiral tapping was also done on other trees in two forms, one a genuine spiral or "full spiral," the other intermediate between spiral and long oblique tapping or "half spiral." These two forms of tapping, both of which in the Gardens' records and in Ceylon were alike called "spiral," are illustrated in plate 5 herewith published. The reader with that before him will for himself realise how very much more the descending sap current is interfered with in the one than in the other. Tree No. 2 which is that in the right hand figure had seven five and a half feet long cuts made in it: these are shown and also there may be seen herring bone cuts of 1905 and 1906 made when the tree was in experiment U or in experiment 6. The same tree was figured in an earlier stage in the plate published with the July 1908 number of the *Agricultural Bulletin of the Straits and F. M. S.* The tree again makes plate 4 of this issue, as it was at its death in 1914, which may be compared with the tree figured in the *Tropical Agriculturist*, xxv., 1906, opposite p. 724: and the plate of the full spiral may be compared with that opposite p. 644.

In 1907, Mr. Ridley took leave on April 22nd, Mr. Fox replacing him, and Mr. Derry proceeding to Penang. Mr. Fox thus took charge of the rubber work, being aided from August to November inclusive, by Mr. C. Boden Kloss who returned to the Gardens for this short time. Mr. Fox maintained the tapping: and the records which he kept are a monument to his diligence. One new experiment was instituted by Mr. Boden Kloss, a comparison of single and twin basal cuts. This experiment was described in the *Singapore Free Press* of

November 7th, 1907, under the title of "Base tapping for rubber trees." The basal tappings were contrasted with herring bone tappings. In the Gardens' records this experiment was called 8 but because there was framed later by Mr. Derry another experiment 8, the basal tappings will be called here V and W according to their degree, V for the single and W for the twinned basal cuts. Other trees which had been experimented with earlier were tapped in their groups, not exactly experimentally, but in a tapping rotation, in connection with which Mr. Fox started and Mr. Boden Kloss kept up a most extensive series of daily observations on the amount of latex which they yielded.

For some reason these valuable and extensive records were kept on separate sheets instead of in the usual books, or they were written up in books which became separated from the proper records, and it was only after weeks of search that the writer found among waste paper all those now recovered. It may be that some are lost, and if so this is a great pity, for the individual tree record is just what is wanted for the work now in hand.

Mr. Ridley returned early in 1908; and to the existing staff was added in April, Mr. T. W. Main, Mr. Derry being now on leave. Mr. Main took charge of the rubber-work together with other duties, which seem to have had preference so that the tapping recorded as having been done in 1908, is very meagre. Mr. Main informs the writer that one record which he kept, was destroyed by white ants. There is an incomplete record of an experiment done in the year on the trees which had served for the experiment 2 of 1904, in which half were tapped by a herring bone and half by basal V: but unfortunately it is unrecorded which trees were treated in the one way and which in the other.

Mr. Derry resumed charge of the tapping work in 1909.

First of all in that year, perhaps by mistake, a few trees, from among those which had made experiment 1 of 1904, were tapped twenty-seven times in thirty-one days. This tapping is here called Z. It did not extend to more than a small portion of the trees of either of the halves into which experiment 1 had been divided: but took some virgin trees.

After this, shortage by reason of deaths was made good by adding new trees to the groups: many of those added were from among trees tapped by Mr. Ridley and Mr. Burgess in 1905.

This done, tapping was recommenced on the old rotation, and into it two new groups of trees called 9 and 10 were introduced.

One real experiment, and one only, was done in this year, a comparison on the "chain gamma" method of making a herring bone which Mr. Boden Kloss had invented, with the ordinary herring bone.

This "chain gamma" was illustrated in the *Agricultural Bulletin of the Straits and F.M.S.*, vi., 1907, p. 389. In it the side cuts as of the herring bone alternate and each is prolonged downwards until it meets the next cut of the other side, its lower part thus serving as the conducting channel, the course of the latex flowing down to the cup being thus along a zig-zag which has feeders at each of its elbows.

" A third report on the experimental tapping of para rubber" was issued by Messrs. Ridley and Derry in the year, wherein (p. 2) it was observed that "tapping on alternate days showed an advantage over tapping daily" and which advocated tapping by a half herring bones following basal tappings. The report further contains much outside the subject of the treatment of the trees.

Although tapping knives had now been adopted in the Gardens and the damage to the trees had become very much less, the tapping periods were still kept short under the argument that the "crop of seeds was . . . . of the first importance . . . . and heavy tapping" might be "detrimental to seed production" and ought to be avoided. Therefore to carry through 30 successive tappings—sometimes a few more and sometimes a few less—was the course pursued; and after the tappings a prolonged rest was given.

In 1910 the last real tapping experiment was done on the Singapore trees. It was a comparison of the full herring bone with the half herring bone, and was done on the trees which had served for experiment 7 in 1906 and 1907. Whether it influenced planting opinion or not, it coincided with a breaking away from the old practice of many cuts.

In this year all the other tapped trees were tapped in a rotation, some of course at a season favourable for a large flow of latex, others at an unfavourable season. Comparisons of yield under such circumstances are not worth much and do not concern us: what does is that the trees were not being *tapped* in tapping experiments.

From the year 1911 to the end of the first quarter of the year 1914 the tapping rotation has been continued. In 1914 it was abandoned as it entailed unproductive work.

Mr. Derry's attention was meanwhile diverted to coagulating experiments, and in 1912 the retirement of Mr. Ridley gave him wider administrative duties, in consequence of which subordinates were left to carry out the tapping and to enter the results. The records of the years 1911 and 1912, have many mistakes in them. These mistakes the writer considers as cases of the copying of wrong numbers and not of the tapping of wrong trees, for it ought not to have been possible by carelessnees for these men to tap wrong

trees seeing how thoroughly Mr. Derry has numbered them: rather, a fault lay in neglecting to verify the written record after it had been made; and it is fortunate that it is no more, for had wrong trees been tapped the result would have been to render of little value the present attempt at constructing the past tapping-history of each tree. Instead the writer believes that he has been furnished with a fairly accurate record of how each of his possible seed-parents has been bled in the past. To have this knowledge is especially important if it be true that tapping interferes with the germinative power and perhaps other functions of the seed. In any case the knowledge of what has happened to the trees is a desirable adjunct to the work now in hand.

The following tables bring into one view the tappings as far as known. There are in all 156 variations, which can be briefly expressed by symbols. The serial tappings under Mr. Derry, Mr. Boden Kloss, Mr. Fox and Mr. Main are denoted in them by consonants thus:—

B. Denotes experiment 1 of 1904 and the rotation tappings which followed it.

C. Denotes experiment 2 of 1904 and the rotation tappings which followed it and also the incompletely recorded experiment 2 of 1908.

D. Denotes experiment 3 of 1904 and the rotation tappings which followed it

F. Denotes experiment 4 of 1904, the rotation tapping which followed in 1905, the experiment 4 of 1906, and the subsequent rotation tappings.

G. Denotes experiment 5 of 1904, the rotation tapping which followed in 1905, the experiment 5 of 1906 and the subsequent rotation tappings.

J. Denotes the experiment 6 of 1904, and the rotation tappings which followed in all subsequent years.

K. Denotes the experiment 7 of 1906 and of 1907 and 1910 with the subsequent rotation tappings.

M. Denotes the experiment 8 of 1909 and the subsequent rotation tappings.

N. Denotes the rotation tappings which were called "experiment 9" from the year 1909.

P. Denotes the rotation tappings which were called "experiment 10" from the year 1910.

R. Indicates the tapping of tree No. 2 which was intermediate between spiral and long oblique, practised on it in the years 1906, 1909, 1912 and 1913..

S. Indicates the true spiral tapping done on several trees in 1906.

Numerals after these letters denote the modifications of the experimental tapping to which the trees were submitted.

Vowels are used to denote the odd tappings which were done from time to time irrespective of any rotation, thus :—

A. Denotes tappings done before 1904.

E. Denotes tappings done by Mr. Ridley in 1905.

O. Denotes tappings done by Mr. Burgess in 1905.

U. Denotes an (apparently mistaken) tapping done in 1905 on twenty trees.

V. Denotes a single basal line cut in 1907.

W. Denotes a pair of these cuts at the same time.

Z. Denotes a mistaken tapping of a few trees done in 1909.

Q. Denotes the tapping of trees in block 2 in 1913.

In cases where a tree was not subjected to one of the rotation treatments from the very beginning, a small letter instead of a capital letter is used to denote its treatment, thus "b from 1906" means that the tree received treatment B from the year 1906: then "Ab from 1906" means that it was tapped before 1904 (A) and that it was put into rotation B in 1906 to make up the number of trees: OWMI, means that the tree was tapped by M1. Burgess in 1905 (O), by two basal cuts by Mr. Boden Kloss in 1907 (W), and was put into "experiment 8" (M) by Mr. Derry in 1909 being one of the trees tapped by a half herring-bone (M1).

The total number of tappings under the different treatments comes out at a small number with regard to the days which elapsed between July 4th, 1904 and March 14th, 1914, when the old order of tapping was abandoned, *i. e.*, 3650; that is to say it was light treatment an regards removal of latex, but up to 1906 it was associated with considerable damage to the cambium in consequence of the nature of the tools used in tapping. All trees with the vowel A, E and O in their symbol are likely to have suffered from other injurious cutting. But such cutting is not associated with the later consonants of the alphabet M, N, P, Q, R, S and Z. But it is associated for two years with the earlier letters B, C, D, F, G, J, K and L.

TABLE

Understand "Days" after

Symbol.	Tapped before 1904.	Tapped in 1904.	1905.	1906.	1907.	1908.
ABI	Yes	Ten oblique cuts superposed in 2 series 15 in 18 with 394 rest	Complete HB. 25 in 25 with 73 rest: 22 in 22 with 174 rest	Complete HB. 25 in 26 with 366 rest	Complete HB. 31 in 44 with 594 rest	...
AZBI	do.	do.	do.	do.	Tapping same, but with 504 rest	...
BI	...	do.	do.	do.	as ABI	...
AB2	Yes	Ten Scattered not-reopened cuts, 15 in 18 with 394 rest	do.	do.	do.	...
AZB2	do.	do.	do.	do.	as AZBI	...
B2	...	do.	do.	do.	do.	...
Eb	...	...	Burgess	...	...	...
Ub.	...	...	Complete HB. 17 in 37 with 271 rest: 22 in 22 with 174 rest	as ABI	as ABI	as ABI
A f3b	Yes	as F3	as ABI	do.	do.	do.
ACI	Yes	10 Rather Long oblique cuts 16 in 52 with 354 rest	Complete HB. 21 in 41 with 43 rest: 24 in 25 with 279 rest	Complete HB. 25 in 51 with 278 rest	Complete HB. 28 in 82 with 205 rest	Either complete HB. or basal V. 34 in 65 with 229 rest
CI	...	do.	do.	do.	do.	do.

ch Numeral.

1909.	1910.	1911.	1912.	1913.	1914
mplete HB 0 in 35 with 50 rest: 30 in 34 with 89 rest	Complete HB. 32 in 33 with 82 rest: 31 in 31 with 75 rest: 29 in 34 with 118 rest	Half HB. 30 in 33 with 141 rest: 30 in 34 with 36 rest	Half HB. 59 in 66 with 152 rest: 30 in 33 with 138 rest	Half HB. 31 in 35 with 154 rest: 31 in 31 with 71 rest: 31 in 34	...
mplete HB. 7 in 31 with 9 rest: 30 in 35 with 150 est: 30 in 34 with 89 rest	do.	do.	do.	do.	...
as AB1	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
as AZB1	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
mplete HB. in 64 with 2 rest: 24 in with 91 rest	Half HB. 33 in 36 with 106 rest: 31 in 32 with 170 rest	Half HB. 30 in 30 with 121 rest: 30 in 32 with 150 rest	Half HB. 59 in 66 with 112 rest: 30 in 33 with 138 rest	Half HB. 31 in 35 with 156 rest: 31 in 31	...
do.	do.	do.	do.	do.	...

TABL

Understand "Days" aft

Symbol.	Tapped before 1904.	Tapped in 1904.	1905.	1906.	1907.	1908.
AC2	Yes	10 Long oblique, cuts 18 in 21 or 22 with 384 or 385 rest	Complete HB. 21 in 41 with 43 rest: 24 in 25 with 279 rest	Complete HB. 25 in 51 with 278 rest	Complete HB. 28 in 82 with 205 rest	Either co plete HB. basal V. in 65 wit 229 rest
C2	...	do.	do.	do.	do.	do.
AC3	Yes	Complete HB. 18 in 22 with 384 rest	Complete HB. 21 in 41 with 72 rest: 25 in 27 with 250 rest	do.	do.	do.
C3	...	do.	do.	do.	do.	do.
AC4	Yes	Five Scattered not-reopened cuts, 14 in 17 with 389 rest	as AC1	do.	do.	do.
C4	...	do.	do.	do.	do.	do.
Ec1	...	...	Director: Complete HB. 21 in 41 with 43 rest: 24 in 25 with 279 rest	do.	do.	do.
Ec3	...	...	Director: Complete HB. 21 in 41 with 72 rest: 25 in 27 with 250 rest	do.	do.	do.
Oc	...	...	Burgess	...	...	...
Uc	...	...	Complete HB. 17 in 37 with 1541 rest	...	...	...
AD1	Yes	Long oblique, 15 in 33 or 34 with 347 or 348 rest	Complete HB. 18 in 35 with 61 rest: 25 in 25 with 260 rest	Complete HB. 25 in 51 with 280 rest	Complete HB. 28 in 68 with 215 rest	Compl HB. Basal V in 64 w 234 r
D1	...	do.	do.	do.	do.	do.

—*Continued.*

ch Numeral.

1909.	1910.	1911.	1912.	1913.	1914.
ompletc HB. 30 in 64 with 32 rest: 24 in with 91 rest	Half HB. 33 in 36 with 106 rest: 31 in 32 with 170 rest	Half HB. 30 in 30 with 121 rest: 30 in 32 with 150 rest	Half HB. 59 in 66 with 112 rest: 30 in 33 with 138 rest	Half HB. 31 in 35 with 156 rest: 31 in 31	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
...	do.	do.	do.	do.	...
...	do.	do.	do.	do.	...
ompletc HB. 30 in 60 with 57 rest: 28 in with 273 rest	Complete HB. 30 in 32 with 155 rest	Half HB. 30 in 34 with 131 rest: 25 in 28 with 75 rest	Half HB. 59 in 66 with 112 rest: 30 in 33 with 138 rest	Half HB. 31 in 35 with 156 rest: 31 in 31	...
do.	do.	do.	do.	do.	...

Symbol.	Before 1904.	1904.	1905.	1906.	1907.	1908.
AD2	Yes	Complete HB. 18 in 20 or 21 with 360 or 361 rest	Complete HB. 18 in 35 with 61 rest: 25 in 15 with 260 rest	Complete HB. 25 in 51 with 280 rest	Complete HB. 28 in 68 with 215	Comple HB. o Basal V in 64 wi 324 res
D2	...	do.	do.	do.	do.	do.
AD3	Yes	Scattered not-reopened cuts, 23 in 26 with 355 rest	do.	do.	do.	do.
D3	...	do.	do.	do.	do.	do.
AD4	Yes	Complete HB. 15 in 32 with 348 rest	do.	do.	do.	do.
D4	...	do.	do.	do.	do.	do.
Ed.	...	...	Director: complete HB. 18 in 35 with 61 rest; 25 in 25 with 260 rest	do.	do.	do.
AOd.	Yes	...	Burgess	...	..	...
Od.	...	...	Burgess: Complete HB. 25 in 25 with 260 rest	as above	as above	as abo
Ud.	...	...	Complete HB. 17 in 37 with 1545 rest	...	...	...
ACId.	Yes	as CI	...	as D	as D	as D
AFI	Yes	Complete H.B 18 in 21 with 358 rest	Complete HB. 25 in 25 with 117 rest	omplete HB. 25 in 25 with 251 rest; 25 in 27 with 310 rest	Complete HB. 41 in 60 with 222 rest	Complet HB. 31 in with 33 rest
FI	...	do.	do.	do.	do.	do.

I.—*Continued.*

each Numeral.

1909.	1910.	1911.	1912.	1913.	1914.
Complete HB. 30 in 60 with 257 rest; 28 in 33 with 273 rest	Complete HB. 30 in 32 with 155 rest	Half HB. 30 in 34 with 131 rest; 25 in 28 with 75 rest	Half HB. 59 in 66 with 112 rest; 30 in 33 with 138 rest	Half HB. 31 in 35 with 156 rest; 31 in 31	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
...	...	...	...	...	...
Complete HB. 32 in 33 with 97 rest; 21 in 24 with 93 rest	Complete HB. 26 in 28 with 63 rest; 29 in 30 with 161 rest	Half HB. 30 in 31 with 113 rest; 30 in 33 with 106 rest; 30 in 34 with 39 rest	Half HB. 59 in 66 with 138 rest; 30 in 31 with 155 rest	Half HB. 30 in 31 with 155 rest; 30 in 57	...
do.	do.	do.	do.	do.	...

TABL

Understand "Days" aft

Symbol.	Before 1914.	1904.	1905.	1906.	1907.	1908.
AF2	Yes	Complete HB. 18 in 21 with 358 rest	Complete HB. 25 in 25 with 117 rest	Half HB. 25 in 25 with 151 rest; complete HB. 25 in 27 with 310 rest	Complete HB. 41 in 60 with 222 rest	Complete HB. 31 in 3 with 331 rest
F2	...	do.	do.	do.	do.	do.
AF3	Yes	Complete HB. 18 in 39 or 40 with 117 or 118 rest	do.	as AF1	do.	do.
F3	...	do.	do.	do.	do.	do.
F4	...	do.	do.	as AF2	do.	do.
Ef	...	...	Director	...	...	...
Of	...	...	Burgess	...	as above	as abov
Uf	...	...	Complete HB. 17 in 37 with 379 rest	Complete HB. 25 in 27 with 310 rest	do.	do.
AF3d	Yes	as AF3	as D	as D	as D	as D
AG1	Yes	Complete HB. 15 in 34 or 35 with 311 or 312 rest	Complete HB 25 in 25 with 169 rest	Complete HB. 25 in 26 with 235 rest	Complete HB. 32 in 33 with 133 rest; 31 in 44 with 770 rest	...
G1	...	do.	do.	do.	do.	...
G2	..	Complete HB. 17 in 38 or 40 with 298 or 300 rest	do.	Half HB. 25 in 26 with 235 rest	do.	...
G3	...	Complete HB. 19 in 44 or 46 with 301 or 302 rest	do.	Complete HB. 25 in 26 with 235 rest	do.	...
AG4	Yes	Complete HB. 24 in 52 or 58 with 282 or 284 rest	do.	do.	do.	...
G4	...	do.	do.	do.	do.	...

I.—*Continued.*

each Numeral.

1909.	1910.	1911.	1912.	1913.	1914.
Complete HB. 32 in 33 with 97 rest; 21 in 24 with 93 rest	Complete HB. 26 in 28 with 63 rest; 29 in 30 with 161 rest	Half HB. 30 in 31 with 113 rest; 30 in 33 with 106 rest: 30 in 34 with 39 rest	Half HB. 59 in 66 with 138 rest; 30 in 31 with 155 rest	Half HB. 30 in 31 with 155 rest; 30 in 57	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
as D	as D	do.	do.	do.	...
Complete HB. 30 in 30 with 88 rest.	Complete HB. 30 in 31 with 148 rest; 30 in 30 with 128 rest.	Half HB. 30 in 30 with 136 rest; 30 in 33 with 133 rest.	Half HB. 59 in 66 with 191 rest; 30 in 35 with 133 rest.	Half HB. 30 in 36 with 233 rest; 30 in 44	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...

TABLE

Understand "Days" after

Symbol.	Before 1904.	1904.	1905.	1906.	1907.	1908.
AG5	Yes	Complete HB. 24 in 52—58 with 282—284 rest	Complete HB. 25 in 25 with 169 rest	Half HB. 25 in 26 with 235 rest	Complete HB. 32 in 33 with 133 rest; 31 in 44 with 770 rest	...
G5	...	do.	do.	do.	do.	...
Og	...	...	Burgess	...	do.	...
AUG	Yes	...	Complete HB. 17 in 37 with 858 rest	...	do.	...
Ug	...	...	Complete HB. 17 in 37 with 236 rest; 25 in 25 with 169 rest	as above	do.	...
AJ1	Yes	Complete HB. 21 or 23 in 32 or 33 with 307-315 rest	Complete HB. 28 in 59 with 128 rest	Complete HB. 25 in 26 with 246 rest	Complete HB. 25 in 25 with 94 rest; 31 in 44 with 811 rest	...
J1	...	do.	do.	do.	do.	...
AJ2	Yes	Complete HB. 23 in 61 with 270 rest	do.	do.	do.	...
AZJ2	Yes	do.	do.	do.	do. except rest 503	...
J2	...	do.	do.	do.	as AJ1	...
AJ3	Yes	Complete HB. 28 in 43 with 286 rest	do.	do.	do.	...
AZJ3	Yes	do.	do.	do.	do. except rest 503	...
J3	...	do.	do.	do.	as AJ1	...
Ej	...	...	Director	...	...	...
AOj	Yes	...	Burgess	...	...	...
Oj	...	...	do.	...	..	...

I.—*Continued.*

each Numeral.

1909.	1910.	1911.	1912.	1913.	1914.
Complete HB 30 in 30 with 88 rest	Complete HB 30 in 31 with 148 rest; 30 in 30 with 128 rest	Half HB. 30 in 30 with 136 rest; 30 in 33 with 133 rest	Half HB. 59 in 66 with 191 rest; 30 in 35 with 133 rest	Half HB. 30 in 36 with 233 rest; 30 in 44	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	..
do.	do.	do.	do.	do.	...
Complete HB. 31 in 32 with 94 rest	Complete HB. 30 in 32 with 47 rest; 30 in 31 with 114 rest; 30 in 31 with 155 rest	Half HB 31 in 34 with 153 rest; 30 in 32 with 53 rest	Half HB. 59 in 66 with 191 rest; 30 in 35 with 138 rest	Half HB. 30 in 37	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
Complete HB. 27 in 31 with 277 rest; 31 in 32 with 94 rest	do.	do.	do.	do.	...
as AJ1	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
as AZJ2	do.	do.	do.	do.	...
as AJ1	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...

TABLE

Understand "Days" after

Symbol.	Before 1904.	1904.	1905.	1906.	1907.	1908.
Uj	...	...	Complete HB. 17 in 37 with rest; 28 in 59 with 138 rest	Complete HB. 25 in 26 with 246 rest	Complete HB. 25 in 25 with 49 rest: 31 in 44 with 811 rest	...
K1	...	...	...	Spiral without pricker 25 in 35 with 257 rest	Spiral 14 in 31 with 1042 rest	...
OK2	...	...	Burgess	Complete HB. 24 in 34 with 257 rest	Complete HB. 30 in 33 with 1040 rest	...
UK2	...	...	Complete HB. 17 in 37 with 1887 rest	...	...	..
K2	...	...	...	as OK2	as OK2	...
K3	...	...	...	Spiral with use of pricker, 25 in 25 with 267 rest	Spiral 30 in 33 with 1040 rest	...
EK4	...	...	Director	Complete HB. 25 in 25 with 267 rest	Complete HB. 30 in 33 with 1040 rest	...
OK4	...	...	Burgess	do.	do.	...
K4	...	...	...	do.	do.	...
EK5	...	...	Director	Double spiral with use of pricker, 25 in 25 with 267 rest	Double spiral 30 in 33 with 1040 rest	...
OK5	...	...	Burgess	do.	do.	...
K5	...	...	...	do.	do.	...

I.—*Continued.*

each Numeral.

1909.	1910.	1911.	1912.	1913.	1914.
Complete HB. 31 in 32 with 94 rest	Complete HB. 30 in 32 with 47 rest; 30 in 31 with 114 rest; 30 in 31 with 155 rest	Half HB. 31 in 34 with 133 rest; 30 in 32 with 53 rest	Half HB. 59 in 66 with 191 rest; 30 in 35 with 138 rest	Half HB. 30 in 37	...
...	Half HB. 26 in 29 with 160 rest; 31 in 33 with 150 rest	Half HB. 30 in 32 with 143 rest; 32 in 35 with 372 rest	...	Half HB. 31 in 34 with 250 rest: 30 in 41	...
...	Complete HB. 26 in 29 with 160 rest; 31 in 33 with 150 rest	do.	...	do.	...
...	do.	do.	...	do.	...
...	do.	do.	...	do.	...
...	Half HB. 26 in 29 with 160 rest; 31 in 33 with 150 rest	do.	...	do.	...
...	Complete HB. 26 in 29 with 160 rest; 31 in 33 with 150 rest	do.	...	do.	...
...	do.	do.	...	do.	...
...	do.	do.	...	do.	...
...	Half HB. 26 in 29 with 160 rest; 31 in 33 with 150 rest	do.	...	do.	...
...	do.	do.	...	do.	...
...	do.	do.	...	do.	...

TABLE

Understand "Days" after

Symbol.	Before 1904.	1604.	1905.	1906.	1907.	1908.
AK6	Yes	...	...	Complete HB. 20 in 33 with 267 rest	Complete HB. 17 in 33 with 1040 rest	...
EK6	...	...	Director	do.	do.	...
OK6	...	...	Burgess	do.	do.	...
K6	...	...	...	do.	do.	...
VM1	...	...	...	...	Basal Single cut. 30 in 33 with 8 rest; 33 in 41 with 663 rest	...
OWM1	...	...	Burgess	...	Basal pair of cuts 15 in 32 with 8 rest; 15 in 26 with 663 rest	...
WM1	...	...	...	...	...	...
M1	...	...	..	...	...	...
M2	...	...	...	...	...	...
VM3	..	...	...	...	Basal Single cut 30 in 33 with 8 rest; 33 41 with 663 rest	...
M3	...	..	...	...	...	...

I.—*Continued.*

each Numeral.

1909.	1910.	1911.	1912.	1913.	1914.
...	Complete H.B. 26 in 29 with 160 rest; 31 in 33 with 150 rest	Half HB. 30 in 32 with 143 rest; 32 in 35 with 372 rest	...	Half HB. 31 in 34 with 250; 30 in 41	...
...	do.	do.	...	do.	...
...	do.	do.	...	do.	...
...	do.	do.	...	do.	...
Half H.B. 30 in 33 with 35 rest; 28 in 30 with 114 rest	Complete H.B. 26 in 27 with 122 rest; 31 in 31 with 208 rest	Half H.B. 30 in 31 with 143 rest; 30 in 32 with 150 rest.	Half HB. 59 in 66 with 134 rest; 31 in 33 with 162 rest	Half HB. 30 in 36 with 203 rest	Half HB. 30 in 32
do.	do.	do.	do.	do.	do.
do.	do.	do.	do.	do.	do.
do.	do.	do.	do.	do.	do.
Two basal cuts, 30 in 33 with 35 rest: 28 in 30 with 114 rest	do.	do.	do.	do.	do.
Chain 30 in 33 with 35 rest: 28 in 30 with 114 rest	do.	do.	do.	do.	do.
do.	do.	do.	do.	do.	do.

TABLE

Understand "Days" after

Symbol.	Before 1904.	1904.	1905.	1906.	1907.	1908.
N	...	...	...	...	...	...
P	...	...	...	...	...	...
Q	..	...	...	...	...	...
AUR	Yes	...	Complete HB. 17 in 37 with 327 rest	Seven long oblique cuts, half spiral, 31 in 31 with 29 rest; 30 in 30 with 29 rest; 12 in 12 with 153 rest; 24 in 24 with 801 rest	...	...
S	...	...	...	Spiral 31 in 31 with 29 rest; 30 in 30 with 29 rest; 12 in 12	...	...
Z	...	...	...	..	...	...

.—*Cotninued.*

ach Numeral.

1909.	1910.	1911.	1912.	1913.	1914.
Complete HB. 34 in 40 with 152 rest; 29 in 37 with 60 rest; 26 in 31 with 102 rest	Complete HB. 30 in 30 with 139 rest; 30 in 30 or 31 with 199 or 200 rest	Half H.B. 30 in 30 with 138 rest; 30 in 31 with 109 rest	Half HB. 59 in 66 with 115 rest; 31 in 33 with 181 rest	Half HB. 30 in 36 with 207 rest	Half HB. 30 in 32
Two basal oblique cuts, 34 in 34 with 35 rest; 31 in 33 with 88 rest; Half H.B. 24 in 24 with 108 rest	Half H.B. 30 in 32 with 202 rest; 31 in 33 with 120 rest	Half H.B. 30 in 30 with 216 rest; 30 in 31 with 105 rest	Half HB. 59 in 66 with 234 rest; 32 in 33 with 162 rest	Half HB. 30 in 31 with 211 rest	Half HB. 30 in 30
...	...	...	...	Half HB. 37 in 45 with 225 rest	...
Seven long oblique cuts, 26 in 31 with 1,402 rest	..	...	Seven oblique long cuts, 20 in 20 with 348 rest	Seven oblique long cuts, 29 in 40	...
...	...	...	...	..	...
Presumedly complete HB. 27 in 31	..	...	..	...	...

Table II.

B. 1.	15 times tapped by two series of 5 superposed oblique cuts	
	255 times by a complete Herring-bone 242 times by a half Herring-bone ...	Total 612 days
B. 2.	15 times by scattered short cuts tree per diem, and after the first year, as B. 1	Total 612 days
C. 1.	16 times by two series of 5 superposed oblique cuts	
	98 times by a complete Herring-bone 34 times either by a complete Herring-bone or by Basals cuts	
	54 times by a complete Herring-bone 275 times by a half Herring-bone	Total 477
C. 2.	18 times by long Oblique cuts and after the first year, as C. 1 ...	Total 477
C. 3.	117 times by a complete Herring-bone 34 times either by a complete Herring-bone or by basal cuts	
	54 times by a complete Herring-bone 275 times by a half Herring-bone ...	Total 478
C. 4.	14 times by scattered slashes and after the first year, as C. 1 ...	Total 475
D. 1.	15 times by long Oblique cuts 86 times by a complete Herring-bone 27 times either by a complete Herring-bone or basal cuts	
	88 times by a complete Herring-bone 206 times by a half Herring-bone ...	Total 422
D. 2.	101 times by a complete Herring-bone 27 times either by a complete Herring-bone or basal cuts	
	88 times by a complete Herring-bone 206 times by a half Herring-bone	Total 422
D. 3.	23 times by scattered slashes and after the first year, as D. 1 ...	Total 430
D. 4.	15 times by a complete Herring-bone and after the first year, as D. 1.	Total 422
F. 1. & F. 3.	273 times by a complete Herring-bone 239 times by a half Herring-bone ...	Total 512

F. 2. & F. 4. 43 times by a complete Herring-bone
25 times by a half Herring-bone
205 times by a complete Herring-bone
239 times by a half Herring-bone ... Total 512

G. 1. 218 times by a complete Herring-bone
209 times by a half Herring-bone ... Total 427

G. 2. 42 times by a complete Herring-bone
25 times by a half Herring-bone
153 times by a complete Herring-bone
209 times by a half Herring-bone ... Total 429

G. 3. 222 times by a complete Herring-bone
209 times by a half Herring-bone .. Total 431

G. 4. 227 times by a complete Herring-bone
209 times by a half Herring-bone ... Total 436

G. 5. 29 times by a complete Herring-bone
25 times by a half Herring-bone
153 times by a complete Herring-bone
209 times by a half Herring-bone ... Total 416

J. 1. 251 or 253 times by a complete Herring-bone
180 times by a half Herring-bone ... Total 431 or 433

J. 2. 253 times by a complete Herring-bone
180 times by a half Herring-bone ... Total 433

J. 3. 258 times by a complete Herring-bone
180 times by a half Herring-bone ... Total 438

K. 1. 39 times in a Spiral
190 times by a half Herring-bone ... Total 229

K. 2. 111 times by a complete Herring-bone
123 times by a half Herring-bone ... Total 234

K. 3. 25 times by a Spiral, a pricker used after the knife
30 times by a Spiral
57 times by a complete Herring-bone
123 times by a half Herring-bone ... Total 235

K. 4. 112 times by a complete Herring-bone
123 times by a half Herring-bone ... Total 235

K. 5. 25 times by a double Spiral a pricker used after the knife
30 times by a double Spiral
190 times by a half Herring-bone ... Total 245

K. 6.	94 times by a complete Herring-bone 123 times by a half Herring-bone ...	Total 217
VM. 1.	63 times by a single basal Oblique cuts 58 times by a half Herring-bone 57 times by a complete Herring-bones 210 times by a half Herring-bone ...	Total 388
WM. 1.	30 times by a apair of basal Oblique cuts the rest as above, i. e., after the first year, as VM. 1 ...	Total 355
M. 1.	As VM. 1 and WM. 1, but without the first line	Total 325
M. 2.	30 times by two basal cuts 57 times by a complete Herring-bone 210 times by a half Herring-bone ...	Total 297
VM. 3.	63 times by a single basal cut 30 times by a chain-gamma 57 times by a complete Herring-bones 210 times by a half Herring-bone ...	Total 360
M. 3.	As VM. 3, but without the first line	Total 297
N.	179 times by complete Herring-bones 210 times by half Herring-bones ...	Total 389
P.	65 times by two basal Oblique cuts. 296 times by half Herring-bones ...	Total 361
Q.	37 times by half Herring-bone ...	Total 37
VR.	17 times by complete Herring-bones 172 times by seven long Oblique cuts	Total 199
S.	61 times by Spiral	Total 61
Z.	27 times by (it is believed) a complete Herring-bone ...	Total 27

As is common knowledge to readers of the Gardens' Bulletin, rubber seed is sold from the Gardens from little tapped trees. The seed bearers are the trees of the letters above, Q excepted. The maximum amount of tapping—on B—comes to less than 17 in every 100 days.

The old tapping rotation has been swept away. It entailed a great deal of unnecessary labour because the trees simultaneously tapped were scattered all over the rubber ground. It was stopped in March, 1914; and instead from May, 1914, the trees of the Gardens have been and will be tapped by blocks or fields as nearly as possible equal. The new arrangement was put into force when in 1914,

Mr. J. J. Bradbery temporarily joined the staff of the department, his planting knowledge peculiarly fitting him for the work. Another change was also initiated; the half herring-bone had always been to the right of the drainage channel; but from 1914 as far as the bark of the trees permits, it has been transferred to the left.

Block 1, as now constituted contains trees numbered between 23 to 416, and intercalations numbered, 1289, 2143 to 2145, 2160 to 2189, and 2505 to 2508. The trees with numbers up to 416 were planted in 1884-1887, except No. 362 and the intercalations which are much younger. Losses by death have been considerable in it. Of the now standing older trees, rather more than one half were tapped before 1904, seventeen were tapped by Mr. Burgess, in 1905 and five were tapped in the group called U. Very few trees escaped tapping in 1904, and those that were tapped fell into every possible group of tapped trees. Of the few trees which were not tapped in 1904, most were tapped in 1905 in one way or another and later (if tapped by Mr. Burgess) incorporated in a rotation. The trunks are much burred and tapping is now difficult. The block is on the left of the path in the lower figure of plate opposite page above.

Block 2, contains trees numbered 2509 to 3004, 3010 to 3042, 3045 to 3048 and 3051 to 3052. All were planted in the year 1904 and so are eleven years old. None were tapped before 1913, when they entered the rotation under the number 11, which in the tables 1 and 2 is indicated by the letter Q. In 1913 groups of trees received artificial manure in different ways, and the whole block was limed as a preparation. Except for the manuring, in age and treatment all the trees are exactly alike; they are evenly spaced, the lines intersected by ditches.

Block 3 contains trees numbered 832 to 1211 with the exception of trees 998 and 999, and contains also 2132, 2140 and 2141, 2134, 2137 to 2139, 3006 to 3008 and 2043 to 3049, as well as a few yet some way from flowering and not yet numbered. The trees with the lower numbers were planted in 1887 both rather irregularly and very much too closely. Only two of the now standing trees were tapped before 1904. A considerable number were tapped by Mr. Burgess (48) and the Director (20) in 1905. About one hundred went into rotation K, and nearly eighty into rotation J. At first no trees went into the rotations lettered B, C and D; but when trees were wanted to replace deaths in these some of them were taken from this Block. Very few went into G. In a general way it may therefore be said that the tapping of the block commenced only in a small way in 1904, chiefly in the rotation J, and a little in F, and that of the many trees untapped in that year, most were tapped either by Mr. Burgess or Mr. Ridley or in rotation K in the next year. In 1907 there was a fresh distribution of the trees not in any rotation, some going to rotation M, and others to various of the rotations and in 1907 another distribution occurred. The number of trees which have died is proportionately half of that in Block 1.

Blocks 4 and 5 are parallel to one another, and contain trees diverse in age. At the south and north ends of block 5 are irregularly placed old trees, the middle part being occupied by isolated older trees among young trees which except for unreplaced deaths are fairly regularly placed. The numbers lie between 435 and 686, 830 and 831, 1290 and 1681 excluding 1480 and 1674 to 1678. The older trees, those with numbers between 435 and 686 were planted—a few in 1884, the majority in 1887: trees 830 and 831 are of 1887. Exact records are lacking in regard to other trees, but their ages vary greatly. Very many trees have been lost from among the oldest. Of those still standing, only four were tapped before 1904. In that year about thirty went into rotation D, rather more into rotation F, twice as many into rotation G, and a few into J. In 1905 a few trees were tapped by Mr. Burgess. In 1909 nearly one hundred and twenty trees were put into rotation N. At the present date there are many trees still unripe for tapping.

Block 5 bears trees numbered between 687 and 828 with the exception of trees 809 to 819, and again between 1674 and 1996 except 1843 and 1844. There are many more old trees on the block than on block 5, the lower numbers among them being all recorded as planted in 1887. The planting is more irregular than anywhere else, and a large number of Casuarinas, Lagerstroemias, Sagos and Caryotas have been left intermixed until lately. Death has occurred extensively among the older trees, and especially from wind. Only one of the still standing trees was tapped before 1904. In 1904 sixty of the trees went into rotation F, G and J. In 1905, Mr. Burgess tapped a dozen other trees. In 1906 a few trees were tapped in rotation K, and in 1907 a few more in rotation M. One hundred more came into tapping in 1910, in rotation N and P. While over the years 1905 to 1912 various trees went into all the rotations except B and C for the replacing of others that had died. The tapping of the block has therefore been very diverse.

Block 6 is a small area with a slight slope containing all that are left of the oldest trees, intermixed with a great variety of other trees; in fact it is not a rubber block. The trees are numbered between 1 and 20, 1287, 2130, 2306, and 2826. The old trees had a variety of tapping, being the first used experimentally.

Block 7 like the last is not a rubber block, but contains scattered trees of Hevea, which bear the numbers 1220 to 1231, 1843 to 1844, 1860, 2114 and 2115, 2348 to 2350. They were seedlings either from seed beds or self sown. Several were tapped in 1907 as experiment W versus V, and then they went in 1909 into rotation M, where also others not tapped in the experiment were placed.

Adjoining block 5, with block 7 on its south side and block 12 on the east is a part of the Lower Garden kept under sago for the present, which will be used for rubber cultivation soon, and will then be divided into four blocks, Nos. 8-11. Scattered rubber trees have

been planted or sprung up self sown on its north side, which bear the numbers 807 to 819 and 1997 to 2113 and younger unnumbered trees are in its South-east conrer. Six were placed in 1908 in rotation M and two used in 1910 for replacing losses in rotation J.

Block 12 was planted up with Hevea in 1913 and has not been tapped yet. The trees bear the numbers between 3101 and 3511. Between every two rows is a ditch. The planting is regular. In 1913 the trees row by row were manured in different ways, otherwise they have all had the same treatment and are all of the same age.

Block 13 contains two rows of old rubber trees, bearing numbers between 1232 and 1254, and between 2116 and 2129, as well as some quite young trees. The old trees were planted in 1896 and 1897. All of them were tapped for 1909, in rotation M, but a few had been tapped in 1907, in the experiment W versus V.

Hevea trees occur in three groups on the Arboretum slopes. There are trees 1212 to 1215 close to the Economic Garden office, trees among which are Nos. 1255, 1256 and 2191 near the Dalvey road, and trees Nos. 1257 to 1281 and 2215 to 2248 near the Assistant Curator's quarters. There is also one numbered tree in the Botanic Gardens in the part nearest to the last, No. 1283. The number of then scattered trees used to be larger for very many associated trees were removed in 1911, on the building of the Assistant Curator's house. Most of such as still stand were tapped by Mr. Burgess in 1905. One was in rotation J from 1904 of another was used to replace a lost tree in rotation J from 1905, a third to replace a lost tree in rotation B from the same year, a fourth from 1909 in rotation G, and a fifth from 1912 in rotation M.

The number of trees in the Garden, which have been registered was about three thousand and three hundred, but the standing trees are now about three thousand. Latterly in trying to improve the plantation the removals have been considerable. In the following table an attempt is made to bring into one view the changes which have occurred in the number of trees of ten years and upwards. As regards most of the trees the age is fairly well known; it was recorded by Mr. Derry in a book, in the year, 1904, as stated in the *Annual Report of the Botanic Gardens* of that year; and similarly the age is known of the youngest trees; but there are a number of self-sown trees the age of which is uncertain. Judging from the girth measurements recorded in 1904, 1906, 1907 and 1909, these trees for the purpose of the table have been assigned to probable years; and though as regards individual trees the error may be considerable, as regards the trees taken collectively it is probably small. The deaths were not recorded before 1904, and are known approximately only for the year 1903. Allowance has been made for a fair proportion. From these trees seed crops have been collected as stated in tables.

TABLE IV.

The Gardens' Seed-Bearers.

Age.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.	1914.	1915.
10 years ...	1310	4	2	4	5	5	23	13	24	71	53	41	34	34	44	16	27	15	11
11 „ ...	95	1300	4	2	4	5	5	23	12	24	71	53	41	34	34	44	16	27	14
12 „ ...	—	90	1290	4	2	4	5	5	22	12	24	71	53	41	34	34	44	16	23
13 „ ...	42	—	85	1280	4	2	4	5	5	22	12	24	70	53	41	34	34	44	16
14 „ ...	—	40	—	80	1270	4	2	4	5	5	22	12	24	70	50	41	34	34	44
15 „ ...	—	—	38	—	75	1260	4	2	4	5	5	22	12	24	70	45	41	34	33
16 „ ...	—	—	—	36	—	70	1250	4	2	4	5	5	22	12	23	70	45	41	30
17 „ ...	—	—	—	—	34	—	60	1231	4	2	4	5	5	22	12	23	70	45	36
18 „ ...	—	—	—	—	—	32	—	35	1127	4	2	4	5	5	22	12	22	70	30
19 „ ...	—	—	—	—	—	—	30	—	34	1119	4	2	4	5	5	22	12	22	63
20 „ ..	9	—	—	—	—	—	—	23	—	34	1106	4	2	4	5	5	22	12	20
21 „ ...	—	9	—	—	—	—	—	—	20	—	32	1088	4	2	3	5	5	22	11
22 „ ...	—	—	9	—	—	—	—	—	—	15	—	32	1084	4	2	3	5	5	14
23 „ ...	—	—	—	9	—	—	—	—	—	—	11	—	32	1072	4	2	3	5	5
24 „ ...	—	—	—	—	9	—	—	—	—	—	—	11	—	32	1036	4	2	3	5
25 „ ...	—	—	—	—	—	9	—	—	—	—	—	—	10	—	32	1014	3	2	3
26 „ —	—	—	—	—	—	—	9	—	—	—	—	—	—	10	—	31	1072	3	2
27 „ ...	—	—	—	—	—	—	—	8	—	—	—	—	—	—	10	—	31	963	3
28 „ ...	—	—	—	—	—	—	—	—	8	—	—	—	—	—	—	9	—	31	863
29 „ ...	—	—	—	—	—	—	—	—	—	7	—	—	—	—	—	—	3	—	29
30 „ ...	—	—	—	—	—	—	—	—	—	—	6	—	—	—	—	—	—	2	—
31 „ ...	—	—	—	—	—	—	—	—	—	—	—	6	—	—	—	—	—	—	2
32 „ ...	—	—	—	—	—	—	—	—	—	—	—	—	6	—	—	—	—	—	—
33 „ ...	—	—	—	—	—	—	—	—	—	—	—	—	—	6	—	—	—	—	—
34 „ ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6	—	—	—	—
35 „ ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	—	—	—
36 „ ...	—	—	—	—	—	—	—	—	%	—	—	—	—	—	—	—	5	—	—
37 „ ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—
38 „ ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
Total ..	1447	1434	1428	1406	1403	1391	1392	1353	1267	1324	1357	1378	1408	1430	1436	1419	1397	1400	1270

Only approximate.

TABLE V.

The Gardens' Seed-Crop.

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1897 ...	...	...	1,400	2,400	1,260	3,100	2,600	2,200	4,175	2,300	900	...	20,335
1898 ...	7,250	35,550	32,505	13,600	1,750	1,200	...	...	2,950	15,200	3,300	...	113,305
1899 ...	2,150	850	3,500	2,150	600	...	100	3,900	121,970	21,850	...	500	157,570
1900 ...	..	8,200	13,500	3,000	...	1,000	...	2,200	46,300	57,000	8,100	2,400	141,700
1901 ...	7,500	15,600	44,200	3,200	...	...	...	2,000	19,000	49,675	10,000	1,000	152,175
1902 ...	...	...	..	4,050	6,300	14,400	...	3,000	22,700	55,390	20,170	900	126,910
1903 ...	...	400	32,400	14,680	3,950	...	...	...	1,575	5,650	19,100	17,150	94,905
1904 ...	9,654	7,500	19,450	500	2,000	1,500	500	2,700	22,250	75,000	21,250	3,875	166,179
1905 ...	2,200	3,000	...	1,400	...	...	6,550	34,900	86,600	37,000	1,000	...	172,650
1906 ...	...	2,170	5,030	3,360	25,025	6,750	3,075	12,175	49,450	16,720	10,350	11,250	145,355
1907 ...	38,850	52,400	36,900	7,250	1,400	750	...	12,000	73,300	105,000	38,000	1,000	366,850
1908 ...	...	...	...	...	...	3,000	...	12,000	12,000	128,000	120,000	40,600	315,600
1909 ...	...	15,000	40,100	29,000	...	...	...	10,600	6,000	70,200	67,200	46,300	284,400
1910 ...	21,000	71,400	61,200	...	2,400	1,600	...	30,000	9,600	38,600	...	83,050	318,850
1911 ...	73,900	28,800	43,800	...	...	...	5,400	64,800	57,600	40,000	5,400	5,500	325,200
1912 ...	600	3,000	...	2,000	5,000	...	...	...	18,800	101,100	38,000	30,600	199,100
1913 ...	...	...	...	6,600	...	6,000	...	2,400	5,400	3,800	16,200	38,400	78,800
1914 ...	40,800	188,100	21,400	...	...	...	...	...	20,400	41,100	49,000	...	360,800

The average crop calculated on the whole of the eighteen years was 196,143 seeds. To eliminate the variation due to seasons, we may take the average of each five years, and then we get :—

Table VI.

Average of years	1897-1901	117,017
„	1898-1902	138,172
„	1899-1903	134,472
„	1900-1904	136,194
„	1901-1905	142,384
„	1902-1906	141,020
„	1903-1907	189,188
„	1904-1908	233,327
„	1905-1909	256,971
„	1906-1910	286,211
„	1907-1911	322,180
„	1908-1912	288,630
„	1909-1913	241,270
„	1910-1914	256,530

The later figures show crops consistently larger figures than the average, the change commencing as table V shows with 1907.

It is not clear to what the increase is to be ascribed, though something may have been done by means of more thorough collecting ; and as commencing in 1904 the grass under the trees was cut over more often in order that the collecting might be better, the trees obtained a little more cultivation than they had, which increased, until now they are clean weeded, except in Blocks 6 and 8.

The yield of the years from 1907 forwards was at the rate of 281,200 seeds per annum, which at 144 seeds to the pound would be nearly 2000 lbs. per annum from about 1,400 trees, or of kernels about 1,200 lbs : and if these yield 42 per cent. of oil the return in oil amounts to just over 500 lbs. It is not convenient to write of the worth of this oil here :—a discussion on that subject with more details will be given in a later issue of this Bulletin. But meanwhile the Gardens records are useful in furnishing a rough estimate of what might be collected of this secondary product from matured rubber estates, where of course tapping would be more extensive than in the gardens, but the spacing of the trees much more appropriate.

That the trees, as is quite to be expected, tend to exhaust themselves in seeding, is evident from the way in which a particularly large cups is generally the sequel of a failure to seed, and is generally followed by a failure in the next seeding season falling about half a year later.

This is how the crops followed one another in the Economic Gardens, Singapore as shown by the records used in drawing up Table VI.

Year.	Early crop.	Late crop.
1897 ...	Insignificant	Small
1898 ...	Rather small—80,000	Small
1899 ...	Insignificant	Rather large—140,000
1900 ...	Small	Rather large—100,000
1901 ...	Rather small—60,000	Rather small—75,000
1902 ...	Small	Rather large—100,000
1903 ...	Rather small	Small
1904 ...	Small	Rather large—120,000
1905 ...	Insignificant	Large—150,000
1906 ...	Rather small	Rather small—90,000
1907 ...	Large—110,000	Very large—200,000
1908 ...	Insignificant	Very large—250,000
1909 ...	Rather small—70,000	Rather large—140,000
1010 ...	Rather large—140,000	Rather small
1911 ...	Rather large—140,000	Large—160,000
1912 ...	Insignificant	Rather large—140,000
1913 ...	Insignificant	Rather small—50,000
1914 ...	Very large—240,001	Rather large—110,000

I. H. B.